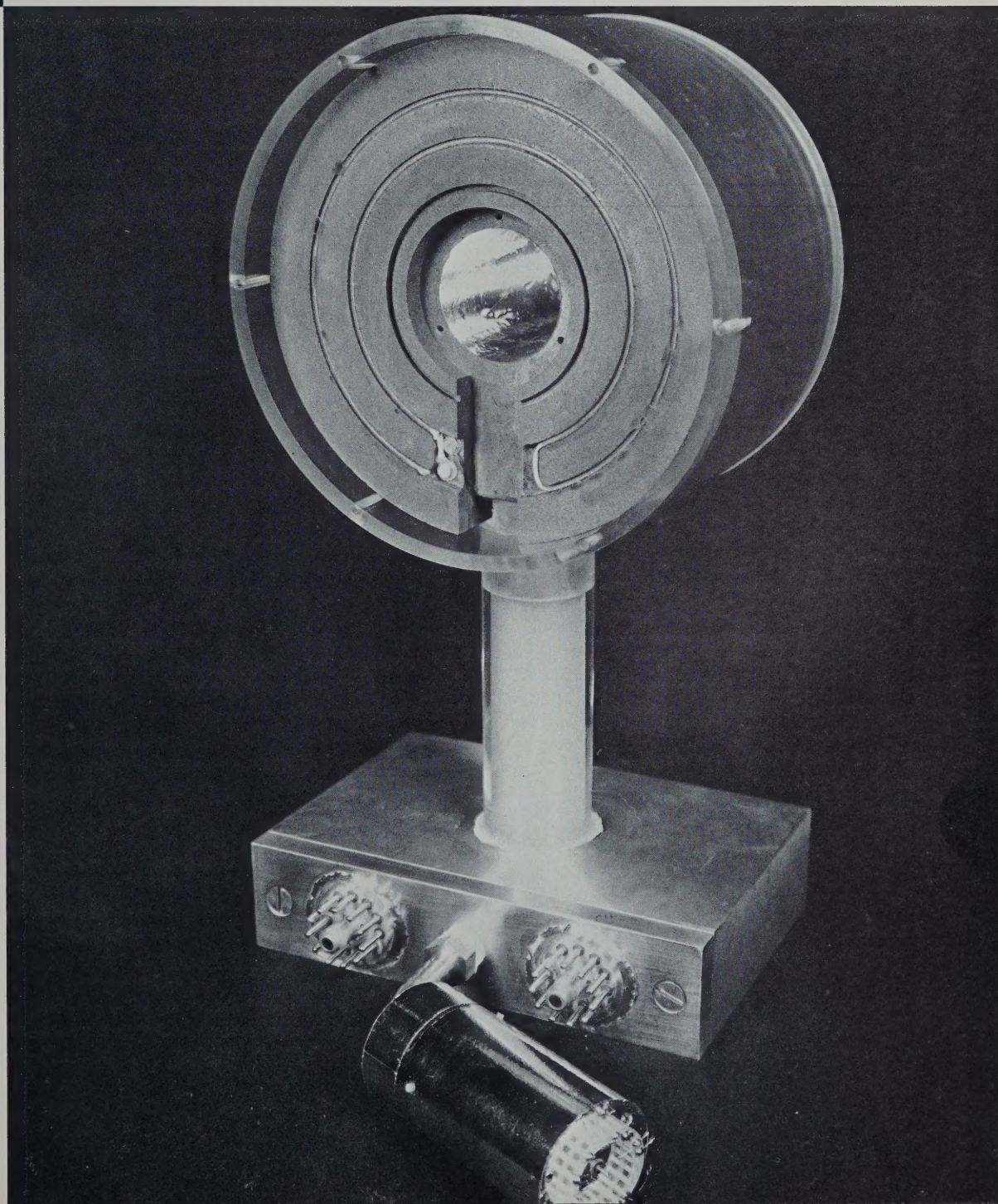
A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

May 1971

NATIONAL BUREAU OF STANDARDS

# Technical News Bulletin



UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

# Technical News Bulletin

MAY 1971 / VOL. 55, NO. 5 / ISSUED MONTHLY

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary
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NATIONAL BUREAU OF STANDARDS
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COVER: *The Bureau has developed a multiple-body calorimeter for measuring absorbed dose of ionizing radiation. Here the portable calorimeter is shown with its back cover and absorption section (foreground) removed.*

Nat. Bur. Stand. (U.S.) Tech News Bull.
CODEN:NBSTA 55(5) 113–136 (1971)
Superintendent of Documents Catalog No. C13.13:55/5
Library of Congress Catalog No. 25–26527

Prepared by the NBS Office of Technical Information and Publications, Washington, D.C. 20234

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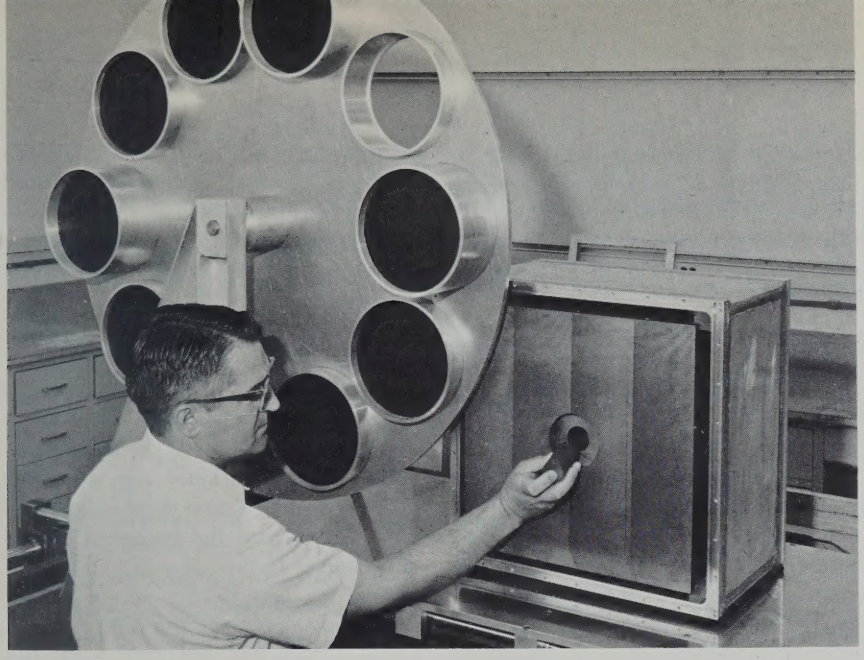
The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

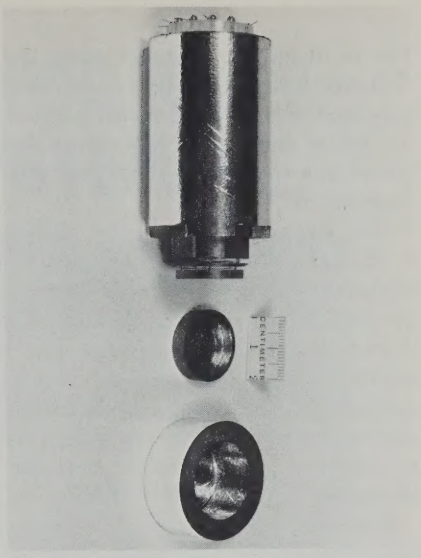
- The Institute for Basic Standards
- The Institute for Materials Research
- The Institute for Applied Technology
- Center for Radiation Research
- Center for Computer Sciences and Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription: Domestic, $3; foreign, $4; single copy, 30 cents. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (June 22, 1966).



*Steve R. Domen inserts the absorption section into the graphite compartment of a new instrument for measuring absorbed dose produced by a radiation beam. This primary standard calorimeter can be remotely positioned in front of one of the ports of a large wheel at left containing various thicknesses of graphite.*



*The components of the absorption section of the two new calorimeters are a core, jacket, and shield. When assembled the jacket lid (center) covers the core, while the shield top (right) fits over both.*

# NEW CALORIMETRIC STANDARD OF ABSORBED DOSE

TWO NEW MULTIPLE-BODY CALORIMETERS have been designed as standards of absorbed dose of ionizing radiation. The calorimeters incorporate two major features: elimination of systematic errors due to temperature gradients and heat removed by the heater wires, and rapid restoration to a preset equilibrium temperature within 1 to 10 minutes between measurements. These features, the results of a newly designed absorption system, a cooling system, and improved circuitry, were developed [1] by S. R. Domen, B. Petree, and P. J. Lamperti of the NBS Applied Radiation Division, with support from the National Institutes of Health.

The primary instrument is large enough to represent a semi-infinite medium. A secondary instrument has the same absorption system as the first, but is smaller, lighter, and more portable. The smaller instrument can be duplicated by other laboratories for use as a local standard of absorbed dose. The primary instrument has a standard deviation of 1 percent for a single run for dose rates of 10 rads per minute.

## DESIGN

The two calorimeters possess identical absorption sections composed of a circular graphite disk core, 20 mm in diameter and 2.8 mm thick, enclosed by a graphite jacket of equal heat capacity. Small thermistors inserted in the pieces serve three functions: recording the temperature rise, heating with a known current to provide an accurate calibration, and heating to restore the calorimeter to thermal equilibrium if undercooled. The reduction of systematic errors and reduced heat loss from the measuring system are the results of the improved design and circuitry. This is accomplished by connecting the thermistor leads of the core to one side of a Wheatstone bridge circuit, and the leads of the jacket to the opposite side of the bridge to take advantage of the natural additive process of the bridge during electrical calibration.

A thermally floating, cylindrical, graphite shield, approximately 35 mm in diameter and 70 mm in length, houses the core-jacket unit. The jacket and shield have cavities through which air can be admitted for cooling the evacuated system. Thin reflective aluminum coatings within and around the core-jacket-shield configuration reduce heat transfer between the bodies.

The major difference between the two instruments is in the size and shape of the graphite block that houses the suspended core-jacket-shield absorber. In the primary calorimeter, the absorber is suspended in a cylindrical hole in a graphite block that measures about 40 x 40 x 30 centimeters. An aluminum box encloses the compartment on four of its six sides.

The front side, perpendicular to the radiation beam, is covered with a thin polyester film, tightly sealed so that the entire instrument can be maintained in a vacuum of about $10^{-5}$ torr (approx. $10^{-3}$ N/m$^2$).

The secondary calorimeter differs in that the core-jacket-shield assembly is mounted in a smaller cylindrical graphite block, 14 cm in diameter by 9 cm thick. The block is mounted in a plastic vacuum chamber. A tubular extension of the chamber provides a means of support, a wiring duct, and a connection to the vacuum or air inlet system.

Each of 10 circular ports on a rotating wheel can be positioned between the radiation source and the calorimeters. Graphite discs of varying thicknesses are placed in these ports to measure absorbed dose as a function of depth along the beam axis. The entire structure is moved by remote control to maintain a constant distance from the radiation source to the front surface of the absorber.

## OPERATION

During an electrical calibration, a known electrical power is supplied directly to the core only. As the core becomes warm it radiates some of its heat. Nearly all of the heat lost from the core is absorbed and retained in the jacket causing it to rise slightly in temperature. The temperature increments of the two bodies are then automatically added by the bridge circuit to give a highly accurate calibration of the instrument.

Prior to an irradiation run, the thermistor in the jacket is switched out of the circuit and replaced by an external resistor of the same resistance. This permits measurement of absorbed dose in the core alone. Since the core, jacket, and shield are all heated by radiation, their temperatures rise together. In practice, the heat loss from the core is usually too small to require correction.

Initial tests of the primary instrument have been made using the NBS electron linear accelerator. The instrument was exposed for 100 seconds at the rate of 200 rads per minute, to produce a temperature rise of about 0.005 °C. A program is now in progress to compare the response of the calorimeter to that of a graphite ionization chamber having an air gap of the same diameter as the calorimeter's core. X-rays and electrons from the linear accelerator, and cobalt-60 gamma rays, will be used.

[1] Domen, S. R., A heat loss compensated calorimeter and related theorems, J. Res. Nat. Bur. Stand. (U.S.), 73C, Nos. 1 and 2, 17–20 (1969).

# Two Nuclear Models are Correlated

The alpha particle model and the shell model for describing the structure of the atomic nucleus are interrelated according to Michel Danos, a nuclear theorist of the Bureau and Vincent Gillet of the Centre d'Etudes Nucleaires de Saclay, France.[1] Through analysis of literature values of nuclear binding energies,* they were able to correlate the two models. Their work will enhance the capabilities of theoretical analysis of many-particle transfer reactions. The analysis of the way structures in a number of cross sections change when going from nucleus to nucleus will also benefit from this research.

One of the first accepted models of nuclear structure was the alpha particle model. This theory assumes the nucleus to be composed of alpha particles (helium nuclei), that is, of nucleons (protons and neutrons), bound together in subgroups. However, in its original form the model could explain only the ground state properties of the alpha particle (nuclei with an atomic number equal to four times the number of alpha particles within the nucleus). The model was therefore abandoned with the advent and acceptance of the shell model.

The nuclear shell—or independent particle—model assumes that each nucleon (neutron or proton) moves independently within the nucleus in separate orbits contained in a shell. The nucleus in general contains nucleons in several shells, some of which are completely filled, others partially filled with nucleons. Each nucleon is acted upon by an average nuclear force produced by the action of the other nucleons.

The quartet model for describing the nuclear structure incorporates the alpha particle model into the shell model. The central point is that the alpha particle of the old model is replaced by a quartet of nucleons. They do not have the same geometrical shape as an alpha particle, but they do have the same features, namely: each nucleon interacts strongly with the three other nucleons of the quartet, and interacts weakly with nucleons of other quartets.

The present analysis is the first search for evidences of quartet behavior in medium and heavy nuclei, although earlier investigations have been carried out [2,3] to explain the properties of low atomic number nuclei in terms of the quartet structure. Using all even-even nuclei for which binding energy data were available, M. Danos and V. Gillet found that the energy required to excite an entire quartet is much smaller than the energy required to excite a single nucleon.

*The binding energy is defined as the energy required to break the nucleus up into free nucleons.

[1] Danos, Michel, and Gillet, Vincent, Evidence for quartet structure in medium and heavy nuclei, Phys. Letters, **43B**, No. 1, 24 (Jan. 1971).
[2] Danos, M., and Spicer, B. M., Quartet structure in light nuclei, Z. Physik **237**, 320–326 (1970).
[3] Arima, Akito, Gillet, Vincent, and Ginocchio, Joseph, Energies of quartet structures in even-even N=Z nuclei, Phys. Rev. Letters **25**, No. 15, 1043–1046 (Oct. 1970).

# DESIGN PACKAGE AVAILABLE FOR NBS RF POWER MEASUREMENT SYSTEM

PRIVATE MANUFACTURERS wishing to produce and market an NBS-developed rf power measurement system, now can purchase the design package from the Bureau's Boulder Laboratories.

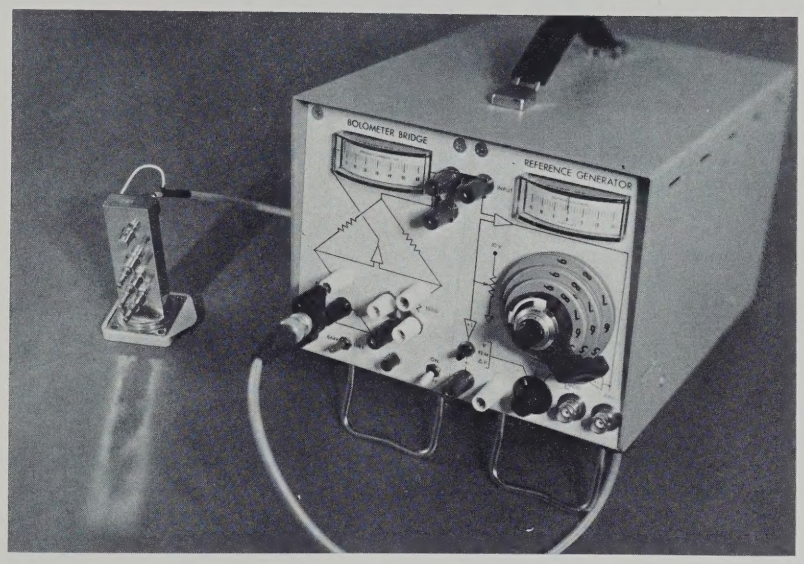
Designated the NBS Type II Power Measurement System,[1] it is not only the most accurate high-frequency and microwave power measurement system available, it is a versatile multifunction instrument which can be used as a precision rf power stabilizer, an accurate dc voltmeter, or a dc voltage source. Power measurements are made by the dc substitution technique.

Weighing only 5.67 kg (12.5 lb.), and measuring 20.8 cm (W) x 17.8 cm (H) x 34.8 cm (D), or 8¼″ x 7″ x 13¾″, the unit replaces an older NBS-designed system which involved some 240 pounds of equipment costing about $18,000. Since components for the Type II system cost about $600 in lots of 100, NBS estimates that the system could be manufactured for less than $2000 per unit. The savings in cost and weight are complemented by a sevenfold increase in accuracy over available commercial equipment (see Specifications, Table 1).

The unit consists of two solid-state modules in a single case—(1) a self-balancing bolometer bridge employing thermistors or barretters, and (2) a reference-voltage generator (RVG), which also serves as a 0–10V dc source or voltmeter and as a precision stabilizer. In the stabilizer mode, the six-decade divider becomes a high-resolution level-set attenuator. The bridge power supply also powers the RVG.

NBS, after developing this equipment and supplying pilot units to the military, is making the design and production information available to commercial manufacturers. Anyone

*Continued on page 113*




*The NBS Type II Power Measurement System, with a typical bolometer working standard, consists of two modules in a single case. Besides measuring rf power accurately, the unit can be used as a power stabilizer, dc voltmeter, or dc-voltage source.*

*Table 1. Specifications*

**SELF-BALANCING BRIDGE**

POWER RANGE: (Depends on external bolometer mount used.)

| Bolometer Mount Resistance: | 50Ω | 100Ω | 200Ω |
|---|---|---|---|
| Available DC Bias Power at 60 mA Bridge Current (Front Panel Meter Maximum): | 45mW | 90mW | 180mW |

ACCURACY: (For a substituted dc power measurement of 10mW rf; 200Ω thermistor: $\gamma = -12{,}300\ \Omega/W$)

| | |
|---|---|
| Total Bridge Error: | ±0.0061% |
| External Voltmeter Error: | ±0.0108% |
| Total Error: | ±0.0169% |

NOISE: Less than 0.05 μW

POWER: 105–130 volts ac, 50–60 Hz, 15 VA.

**REFERENCE VOLTAGE GENERATOR**

OUTPUT VOLTAGE RANGE: 0–10 V.

ACCURACY: ± 15 ppm of reading immediately after calibration.

DIVIDER: 6 place, 1 ppm resolution.

STABILITY: (For 30 days at constant temperature, after 30 minute warmup.) 100 ppm of setting plus 10 μV.

**VOLTMETER**

RANGE, ACCURACY, AND STABILITY: Same as RVG above.

**POWER STABILIZER**

OUTPUT CURRENT: PIN diode control—5 mA max.
Ferrite control—300 mA max.

STABILIZATION FACTOR: $\Delta P_{rf}$ out/$\Delta P_{rf}$ in $\leq 10^{-6}$
(At 0.1–10 mW rf in a 200-ohm thermistor leveling detector.)

# RAILWAY TEST CARS RENOVATED

THE BUREAU has recently modernized and renovated its two railway tests cars used to calibrate railway master scales and commercial track scales. The cars were equipped with new diesel generators, new hydraulically operated cranes for loading and unloading weights, and a new electrical system for controlling the hydraulic system.

The nation's railroads carry millions of tons of freight monthly, including almost every type of commodity sold in the marketplace. The railroads charge a fee for shipment based on the weight of the shipment and the distance it is being carried. Whether the receiver of a commodity pays a fair price for this service depends on the accuracy of railway track scales. In turn, the accuracy of these scales depends to a large extend on a continuous railway track scale testing program carried on by NBS.

The NBS cars are unique in their ability to test in 10 000-pound increments, while the railroads operate composite test cars of one nominal value and can test at that value only. The cars each carry a test dolly that is itself a 10 000-pound calibrated weight and 7 other 10 000 pound weights for a total of 80 000 pounds. The dolly and weights have been calibrated to a precision of $\pm 0.2$ pound per 10 000 pounds.

The railroad track scale testing program began in 1913, after NBS investigations of railroad weighing uncovered errors ranging from 30 to 21 600 pounds per 100 000 pounds. The investigations also showed that except in rare cases the testing of railway track scales was conducted by unqualified personnel using either inadequate or unsuitable equipment. As a result of these findings, the American Railway Association (now the Association of American Railroads) and the Bureau signed an agreement providing for free rail movement of NBS testing equipment by the railroads, and free calibration of railroad-owned master railway track scales by the Bureau. In 1928 an NBS Master Scale Depot was established in Clearing, Illinois, and has since served as a base of operation for NBS testing equipment and as a large weight calibration center. Railway-owned scale test cars are also calibrated at the Master Scale Depot.

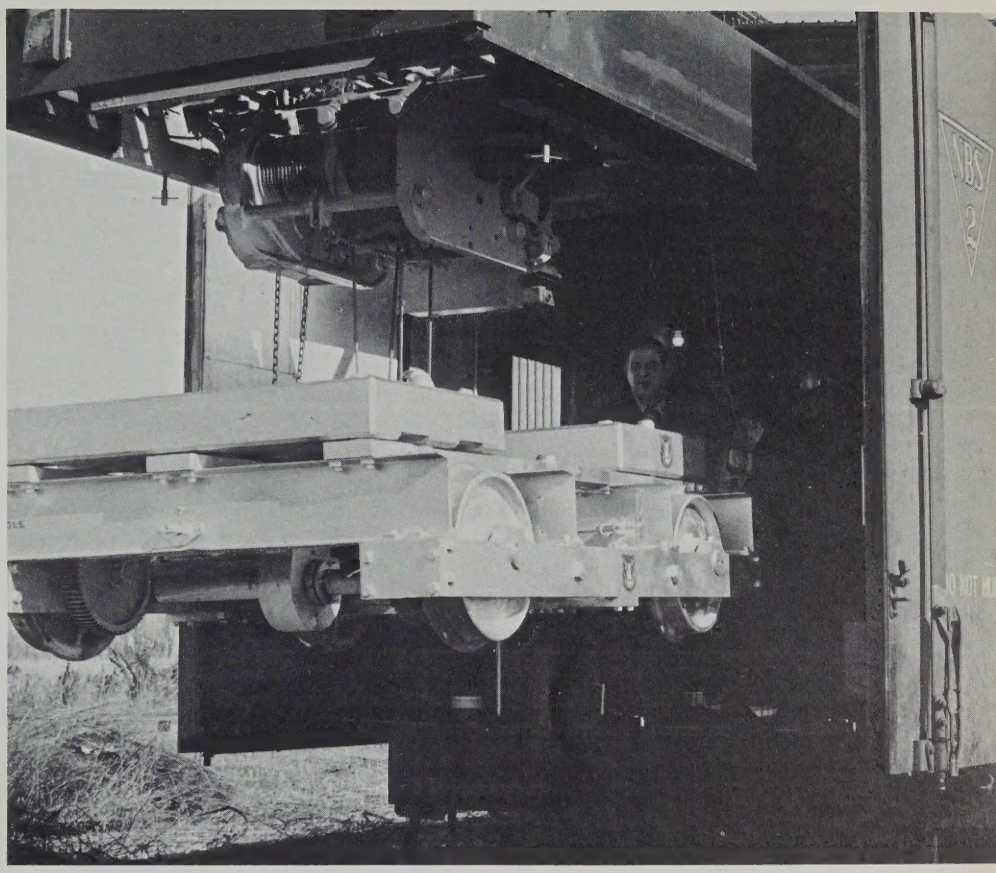
Most railroad weighting is interstate by nature, but regulatory authority is scattered piecemeal between Federal and local agencies. The Bureau's responsibility in this area is to maintain traceability between the national standards and the 17 master railway track scales. However, in addition to the master scales, there are many other commercial track scales and scale test cars in use. Regulatory authority over commercial track scales and test cars rests solely with state and local weights and measures officials. Thus, successful standardization of railroad weighing can only be accomplished through cooperation between Federal and local governmental agencies and the railroads. The ideal situation seems to be one in which NBS furnishes the expertise and equipment for adequate tests, and the states furnish the regulatory authority to bring about compliance. In this way the Bureau can provide a valuable service to the states, the railroad industry, and the consumer.

In 1968 an updated agreement was signed by the Association of American Railroads and the Bureau. Under the agreement each of the 17 master track scales is calibrated annually by NBS, and as before the member railroads provide free rail movement of NBS testing equipment to and from the scales scheduled for testing. Itin-

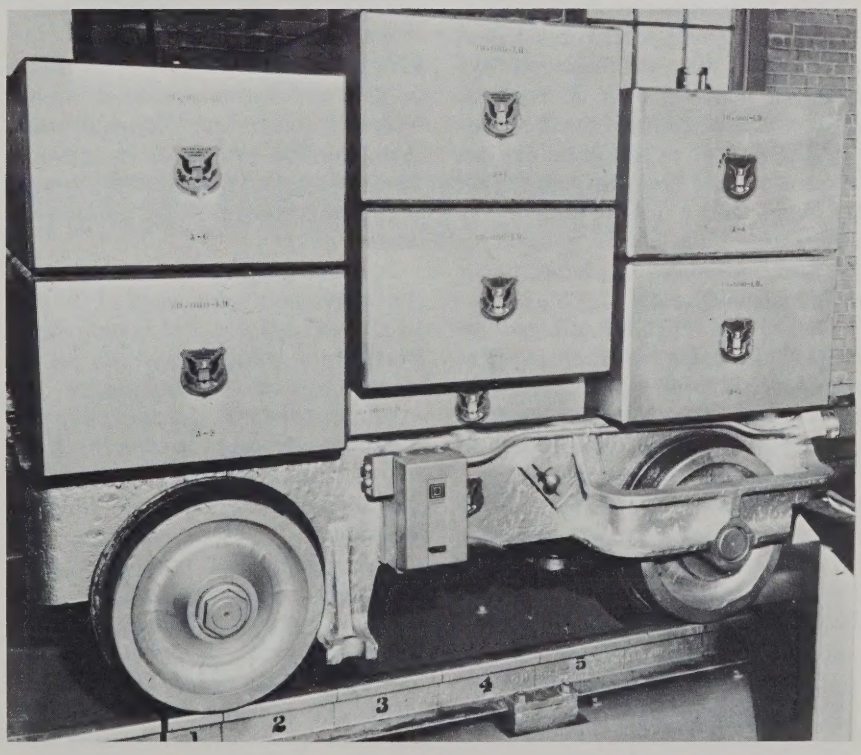
eraries are planned six months in advance by the AAR, and other railroad and industrial track scales along the scheduled routes can be tested by the Bureau on request. Railway-owned scale test cars can be calibrated on request at the Master Scale Depot in Clearing, Illinois. Where tests are desired in a location not served by any of the foregoing NBS personnel will calibrate railroad test cars on an NBS-calibrated commercial scale for an established fee. The Bureau will also act as a technical arm to the railroad industry and the states in the development of better testing procedures and equipment. Conventional mechanical static weighting devices presently are being replaced by all new, fully electronic motion-weighing systems capable of weighing moving railroad cars at speeds of up to five miles per hour.

The current railway track scale project is under the direction of Richard N. Smith, Program Manager, NBS Office of Weights and Measures. Mr. Smith works both formally and informally with state officials and officials of the Association of American Railroads in arranging appropriate itineraries. NBS hopes to enter into formal agreements with the states setting standards that railroad weighing devices must meet, and offering NBS cooperation in the maintenance of such standards. The states have already agreed to provide a state official to witness NBS scale tests, and to provide the necessary regulatory authority.

The Bureau anticipates testing an average of 400 commercial scales and 35 railroad-owned test cars each year. Actual calibration activities are carried out by Allen and Ben Banks, engineering technicians in the Office of Weights and Measures.



*Allen Banks (upper right) unloads the test dolly from the railway test car.*




*Test dolly and six 10,000 pound weights (at right) used to calibrate railway master scales and test cars.*

# STEEL PILINGS IN SOILS

## Permafrost Soils Added to Test Sites

THE BUREAU has completed the second phase of an investigation on the performance of steel pilings in soils. This second phase, covering a number of previously uninvestigated soils, including the permanently frozen soils of Alaska,[1] confirms the results of the first phase;* in general, the strength and useful life of steel piles are not significantly affected by corrosion in undisturbed natural soils. Both phases were conducted by the late Melvin Romanoff** of the NBS Institute for Materials Research with the cooperation of the American Iron and Steel Institute and the U.S. Army Corps of Engineers. The purpose of continuing this work is to provide more accurate estimates of the useful life of pilings.

Data were obtained from inspections of steel pipe-, steel H-, and steel sheet-pilings that had been exposed underground from 6 to 50 years in various locations throughout the country. The steel pipe- and H-pilings are frequently used as foundations for buildings and other structures; as steel sheet-piling, they are used as structural members of dams, floodwalls, and bulkheads.

The soils in which the pilings were exposed differed in both their physical and chemical properties. In texture, the soils varied from porous sands to impervious clays to permafrost. Soil resistivities ranged from 78 ohm-cm (indicating the presence of large quantities of soluble salts, normally corrosive under disturbed soil conditions) to over 45 000 ohm-cm (indicating the absence of soluble salts). The pH of the soils ranged from 4.1 to 8.8.

Three methods were used in installing the piles—driving, dry augering, and, in permafrost soils, steam thawing. Driven piles remain sturdy. However, with the dry augering process, it was necessary to backfill with material varying in content from riprap, cinders, and slag, to combinations of sand, silt, loam, and clay. With steam thawing, piles were installed directly in the silt-water slurry formed during thawing and needed little or no backfill.

Nine steel specimens were installed in Alaskan soils, which are composed of two layers—a layer that thaws and freezes annually (to a depth of approximately 5 ft) and a permanently frozen (permafrost) layer beneath the thaw layer. The lifetimes of the piles in such soil do not appear to be affected by corrosion. No significant corrosion was evident at the ground line, in the thaw layer, or at the boundary between the thaw and permafrost layers.

In other geographic locations, onsite inspections were made of pilings in 17 floodwall and dam installations. Because the pilings could not be removed without disturbance to the existing structure, soil samples and corrosion-product scrapings were taken from exposed portions of the pilings and examined in the laboratory.

Inspections of 26 steel piles (22 bare and 4 tar coated), exclusive of the Alaska-site piles, showed that corrosion was generally confined to the above-ground portions of the specimens. The probable explanation for the minor to moderate corrosion that affected these piles is that a large galvanic corrosion cell was created between the upper and lower portions. In such a galvanic cell, the upper portion of the pile (in general a much smaller part of the entire pile length) would be cathodic to the much larger portion of the pile driven into the natural soil. With this large difference in area between the two, the amount of metal sacrificed by the anode in protecting the relatively small cathode is negligible. In September 1966, piles were installed in Montreal, Quebec, where the physical and chemical properties of the soil provide suitable conditions for testing this hypothesis. It is expected that future data will be a valuable supplement to these investigations.

The 1962 NBS study [2] contributed important observations on the corrosivity of soil environments on pilings. It disclosed that pilings in "undisturbed" soils, that is, pilings driven into the natural ground, are not materially affected by corrosion. Pilings in "disturbed" soils, that is, pilings placed in trenches or excavations and backfilled, can suffer severe corrosion. Earlier correlations [3] made between corrosivity and certain soil properties (type, drainage, resistivity, pH, and chemical composition) were shown to be invalid for "undisturbed" soils. The differences in corrosion between the disturbed and undisturbed soils are attributed to the differences in oxygen concentration. Apparently, undisturbed soils are so deficient in oxygen a few feet below the ground line or below the water table zone that corrosion is negligible regardless of other soil properties.

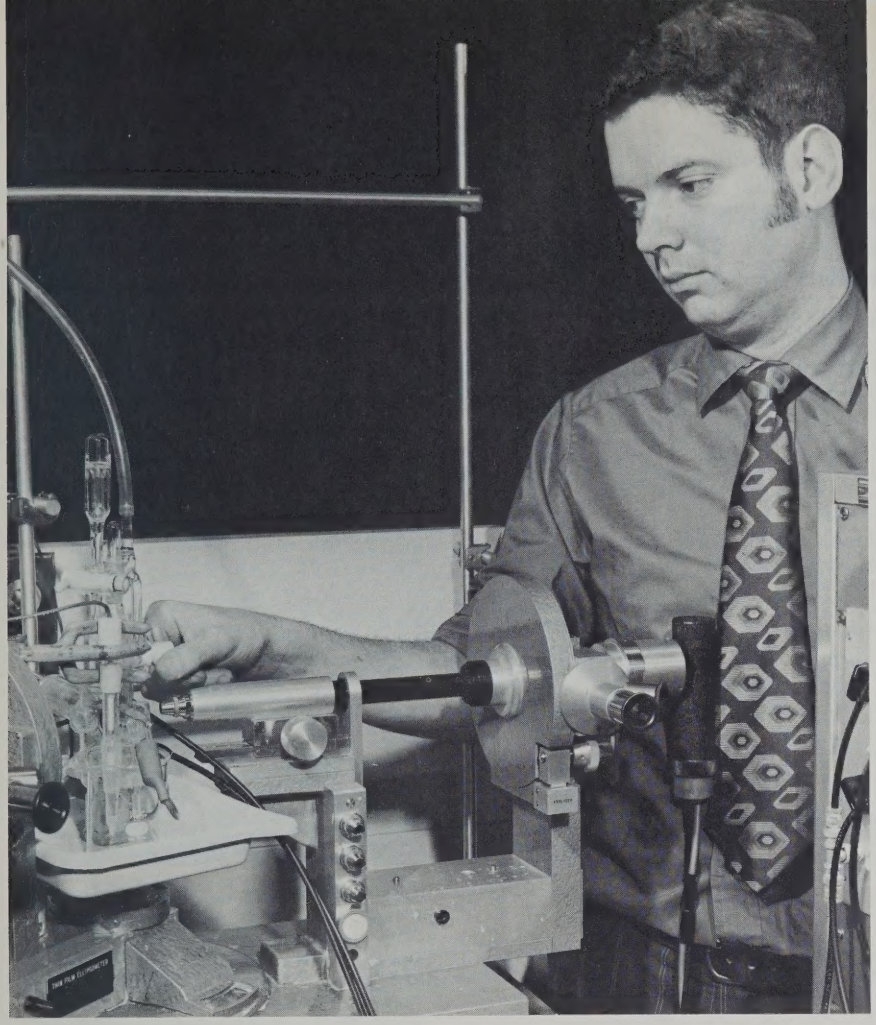
*Completed in 1962.

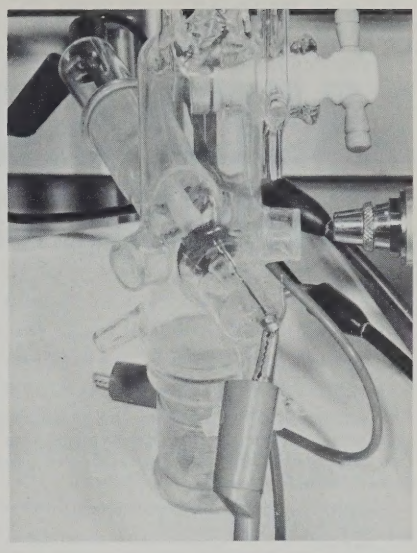
**The NBS work is being continued by William F. Gerhold.

[1] Romanoff, M., Corrosion evaluation of steel test piles exposed to permafrost soils, Proceedings 25th Annual Conference NACE (National Association of Corrosion Engineers), Houston, Texas, 6 (March 1969).

[2] Romanoff, M., Corrosion of steel pilings in soils, J. Res. Nat. Bur. Stand. (U.S.), **66C3** (Engr. and Instr.), 223–244 (July–Sept. 1962). See also, Corrosion study of steel piling in service, NBS Tech. News Bull. **46**, No. 11, 164–165 (Nov. 1962).

[3] Romanoff, M., Underground Corrosion, NBS Circ. 579 (1957). Available as **PB–168350, Underground Corrosion**, from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, Va. 22151, for $3.





*Closeup of the glass electrolytic cell used in studying the breakdown of passive films on metals.*

*John R. Ambrose opens a gas intake valve in a check of apparatus used to study the breakdown of passive films on metals. Apparatus includes an ellipsometer (light beam enters glass reaction cell from left and is detected at right) and an electrolytic cell (left in pan).*

# PASSIVE FILM BREAKDOWN STUDIED

Iron belongs to a group of metals exhibiting the phenomenon of passivity—the formation of an oxide film acting as a barrier to further metal dissolution. The passive film may be generated either by exposure to a suitable oxidizing environment, or by driving the potential to values where, in a given environment, the oxide film forms.

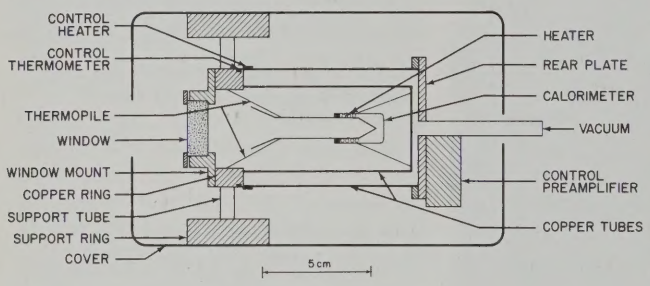
However, of sites where defects within the oxide either are present or are subsequently produced, the material is particularly susceptible to severe localized corrosion, or pitting. Those factors which cause film damage and result in pitting are being studied as part of a research effort of the Bureau to better understand corrosion processes. J. R. Ambrose and J. Kruger of the NBS Metallurgy Division have investigated the destruction of passive films on iron by chloride ions [1] and have observed the onset of breakdown with ellipsometry and current density measurements. Chloride ions were a logical choice for study, considering the corrosive effects of sea water and chloride-rich soils. Partial support for the project was from the Office of Saline Waters, Department of the Interior.

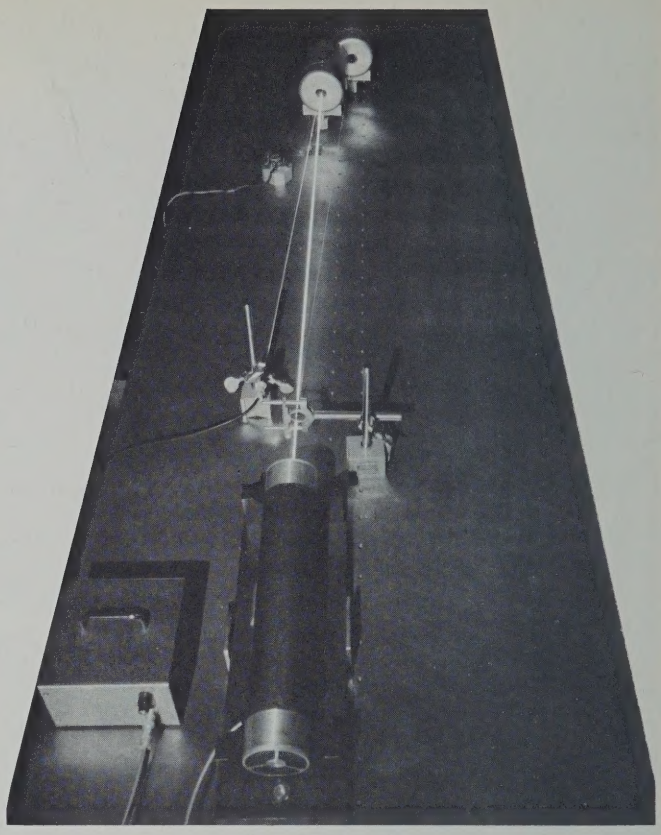
The results of this work suggest film breakdown can be initiated by chloride ions ($Cl^-$) penetrating the film and migrating to the oxide-metal interface. The path thus generated is of sufficiently high conductivity to allow diffusion of ferrous ions through the film and into the solution. As this action persists, local metal dissolution produces a pit. Such a pit completely penetrating, for example, an underground iron pipe carrying fuel gas could have a disastrous effect.

*continued on page 130*

# SYSTEM AIDS LASER SAFETY MEASUREMENTS

*This isoperibol (constant-temperature surroundings) calorimeter compares laser power and energy directly to electrical quantities. The apparatus is roughly cylindrical and symmetrical about a horizontal axis.*



*Laser/calorimeter setup employs a laser (foreground), beam splitter (held in clamp) and two calorimeters (rear).*

*Approximately 92 percent of the laser-beam energy passes through the beam-splitter to the calorimeter on the left while the remaining energy is reflected internally by the beam splitter. After two reflections, approximately 0.16 percent is directed to the calorimeter on the right.*

*If the calorimeter on the left is calibrated electrically and the beam ratio of the beam splitter is accurately known, the energy in the weak beam (directed to the calorimeter on the right) is accurately known. Then, the calorimeter on the right, or any other energy-measuring device in its place, can be calibrated at these very-low energy levels.*

*The devices to the left of the main beam, an electromagnetically actuated shutter (above) and a photo-detector, control and detect the same time interval during which the laser beam strikes the calorimeters. The beam reflected from the calorimeter window is detected by photodetectors.*

DEVICES THAT MEASURE laser power and energy at microwatt levels—close to the threshold of eye-retina damage—can now be calibrated to an accuracy within a few percent. Such precise calibration is achieved with a calorimetric system developed by E. D. West, W. E. Case, A. L. Rasmussen, and L. B. Schmidt at the Bureau's Boulder Laboratories, for the Southwestern Radiological Health Laboratory (SRHL), U.S. Department of Health, Education, and Welfare. SRHL is responsible for making measurements under Public Law 90–602 covering laser-safety requirements. Their instrument accuracy now is traceable to NBS basic electrical standards.

In this calorimetric system, two calorimeters that have been calibrated electrically are used to calibrate a beam splitter. Then, using one of the calorimeters as a beam monitor, the beam splitter is used to produce accurately known beams at the eye-damage-threshold level. SRHL calibrates their field detectors at this level to assure reliable laser-safety measurements. Operating throughout the visible region, the calorimeter measures energy directly from 0.01 to 20J or power from 50$\mu$W to 3W.

SRHL is particularly concerned about measuring low-power lasers that can inflict damage on the retina of the human eye. The threshold of damage to the rods and cones of the retina occurs somewhere at the 10 to 100$\mu$W levels. Laser light of $\approx$0.4 to $\approx$1.6$\mu$m wavelength will penetrate to the rear of the eye and can damage these rods and cones.

Calibrating a device to measure laser power and energy is the process that translates the output of the device into watts or joules based on NBS-maintained electrical standards. Comparing laser outputs directly to basic electrical standards offers the advantage of fewer steps in the calibration process and reduces the associated propagation of errors. These more-direct measurement methods are the object of a continuing NBS program. The main thrust of NBS work is to apply calorimetric methods to measuring laser power and energy.

Recently the work has been directed toward developing calorimeters that are simple enough for nonexperts to operate, rugged enough to ship between laboratories, and accurate enough to provide a means of referring laser power and energy to the NBS electrical standards—a reference calorimeter.

The calorimeter consists of a copper cylinder with a conical mirror at the open end and a small cone closing the other. The cylinder is blackened inside by oxidizing the copper to make it a good absorber, and is gold-plated on the outside. The closed end is fitted with a thin cylindrical copper shield soft-soldered to a copper ring to enclose a calibrating electrical heater wound on the outside of the calorimeter.

The space between the calorimeter and its constant-temperature surroundings is evacuated to reduce heat transfer. The constant-temperature surrounding consists of two coaxial copper cylinders soldered to a copper ring. Within the inner cylinder, which is closed at one end except for four small holes, the calorimeter assembly is suspended by an 8-junction thermopile. The front is sealed with a borosilicate glass window and the whole assembly is mounted on a heavy support ring by means of three thin-wall stainless steel tubes. An anodized aluminum cover surrounds this entire assembly. Constant-temperature control of the surroundings is achieved with a control heater wound on the outer surface of the surroundings and a resistance bridge wound in the heavy copper ring.

Calorimeters of this type eventually will be available to calibration laboratories as a check on their overall laboratory accuracy and precision.

Besides reducing the number of steps in the calibration process, calorimetry has a number of other advantages. It is a technique that has been in use for about 100 years, thereby making available a large amount of information on the design and operation of calorimeters. Calorimeters can be shaped to approximate a total absorber and thus reduce the dependence of the calibration on the wavelength of the laser. A calorimeter will retain its calibration factor for a very long time, unless it is damaged by a gross error, such as exceeding the maximum ratings for power density or energy. Finally, calorimeters can be adapted to a broader range of laser power and energy than other methods.

# Underground Telephone Cable Shields

## COPPER SUBSTITUTES EVALUATED

The first corrosion data on possible substitutes for copper used in underground telephone cable shields have been released by NBS and the Rural Electrification Administration, U.S. Department of Agriculture.[1] Of 35 various bare and coated metal specimens buried for one year, five retained excellent corrosion protection properties, even under the most adverse conditions.

Because of its high conductivity and resistance to corrosion, copper is generally the most desirable shielding material. However, the rising cost and fluctuating availability of this metal make it difficult for the electrical industry to meet increasing demands for underground cables, and stimulated the search for a suitable and economical replacement for copper. Like copper, the substitute must be resistant to soil corrosion, highly conductive, flexible, easily corrugated and formed, and resistant to rodents, particularly gophers.

For this project, the late Melvin Romanoff* (NBS) and Gerald A. Lohsl** (REA) arranged 31 different combinations of metals and plastics and 4 hardware items as experimental shields, which they inserted in actual cable jackets and buried at six NBS corrosion sites. Based on NBS experience since 1928 in soil corrosion, the sites were known to be representative of as wide a range of soil as can be found in the United States, from moderately to extremely corrosive.

Other adverse conditions were simulated in addition to the corrosive soil environments. Portions of the outer jackets of the cables were removed or cut to simulate damages that might occur during field installation or those caused by lightning or rodents. Corrosion was further accelerated in some of the specimens by coupling a copper strip to the shield, creating a galvanic cell between the shield and the copper metal.

Five configurations of cable shield systems provided excellent protection in all soil environments after one year of exposure: 1) 5-mil alloy of copper, iron, and phosphorus, 2) 5-mil type 304 stainless steel, 3) same as 2 but coupled to copper, 4) 3-mil type 211 stainless steel bonded with plastic to 8-mil aluminum, 5) same as 4 but coupled to copper. However, final evaluation will not be made until completion of the program in five to eleven years. Until that time periodic inspections will be made of remaining duplicate specimens.

*The NBS work is being continued by William F. Gerhold.

**Mr. Lohsl is no longer with REA. The REA work is being continued by W. E. Williamson.

[1] For further details, see Lohsl, G. A., and Romanoff, M., Progress Report on Corrosion Evaluation of Shielding Materials for Direct Burial Telephone Cables, Eighteenth International Wire and Cable Symposium, Atlantic City, N.J., Dec. 3–5, 1969.

*Architect's rendering of a row of townhouses constructed from several modular units.*

# BREAKTHROUGH
## HOUSING UNIT UNDERGOES EVALUATION

THE FIRST full-scale factory built housing module constructed for HUD's operation BREAKTHROUGH recently arrived at the Bureau to undergo several weeks of evaluation. Rigorous tests on the unit will determine if such industrialized housing can be successfully built and shipped for erection on sites miles away and still maintain performance standards. The evaluation will mark the first occasion that such housing has been directly designed to meet performance criteria and tested to see if the criteria are met.

The Building Research Division will conduct the tests on the unit—a prefabricated 60-foot, 30 000-lb, module—constructed by Levitt Technology. The prototype unit is the top front portion of a two-living unit building. The module is comprised of three bedrooms and a 20-foot long cathedral ceiling of a first-floor living room.

The shipping procedure from Kalamazoo, Michigan, was actually part of the testing program. Part of this evaluation was a "bump test" in which the railway car loaded with the module was rammed by another car to test the unit under simulated coupling action. Careful checks were made from the construction site of the unit through its 500-mile journey along lines of the Penn Central, and C & O/B & O railroads to determine whether any structural deformation or other damage had occurred in transit.

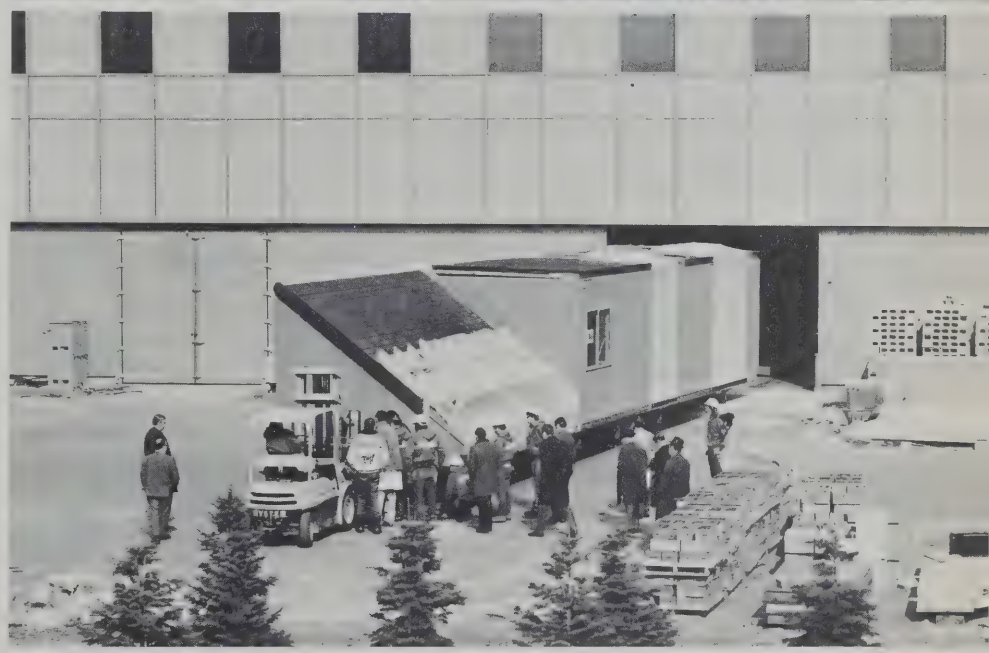
The Bureau will evaluate the module solely on the basis of performance criteria, which state the ends desired (for example; a wall shall withstand 90 mile-per-hour winds) instead of specifying the means of accomplish-

ment (example; wall uprights shall be spaced 16 inches on center). One goal of performance standards is providing a means for introducing innovations, which are not possible under many existing buildings codes.

Initially, the module will be subjected to racking tests in which force is applied by pneumatic jacks horizontal to the walls in simulation of windloads. Strain gages attached throughout the module yield stress/strain data during these tests. Impact tests will also be conducted on the walls and floors. In the floor test a weighted bag is dropped from a holding rack three feet above the floor. Transducers detect vibrations to determine vibration damping characteristics. For wall impact tests the weighted bag, suspended on a line, is swung into the wall. These tests simulate a person falling into or bumping the wall for obtaining strength-to-fracture criteria. Other tests to determine fire safety and effectiveness of resistance to flow of smoke and toxic gas are anticipated.

HUD's objectives for operation BREAKTHROUGH are far-reaching and include the following: To develop increased production of housing to assure the supply needed for our total population in the years ahead. To modernize zoning regulations. To attract into the housing business architects, planners, suppliers, engineers, a broad range of industrial capacities, financial institutions, management organizations, builders, and developers that have the ability to develop improved housing system approaches.

*Continued on page 113*



*After arriving at a railroad siding in Gaithersburg, Maryland (upper right) the 60-foot modular unit was transferred to a flatbed trailer for its 1 mile trip to the Bureau's structural laboratory.*

*The modular unit is being positioned (center right) in the Bureau's structural laboratory.*

*Factory-built module with testing instrumentation installed (right) NBS is evaluating the full-scale structure by subjecting it to racking and floor and wall impact tests.*

# FIPS NOTES

## ADP SOFTWARE INFORMATION RESOURCES

As a specialized information center for the computer sciences and technology, the Office of Computer Information (OCI), Center for Computer Sciences and Technology, has accumulated and organized several subfiles of scientific and technical information, ranging from a general collection of archival and current publications to a more selective collection of catalogs and lists describing computer programs available for sharing. The programs and packages whose descriptions make up the latter file run the gamut in availability from free to any user who requests one—with little or minimal documentation and no assurance that it will run on the requestor's computer configuration—to fully-documented, quite costly proprietary software, with the responsibility for performance to specifications vested in the offering company.

Sources of these catalogs and lists are many and varied. In addition to the over 15 well-known Computer Users Groups, whose media for implementing program sharing are familiar to participating members, the managers and personnel of operating installations, there are subject/problem oriented groups, such as the American Bankers Association, the American Association of State Highway Officials, the Automated Procedures for Engineering Consultants, Inc., and EUDCOM (Interuniversity Communications Council), who have assembled information on and prepared indexes to programs originating in their respective memberships. In some cases, responsibility for establishing a data bank and index has been delegated to a University Department, e.g., the Indiana University Chemistry Department's "Quantum Chemistry Program Exchange" and the IIT Research Institute Engineering Mechanics Division's "IITRI Structural Mechanics Computer Program Library for Various Industrial Sponsors."

The software industry itself has produced or contributed to the production of new publications whose entire contents or significant sections are devoted to disseminating information on computer programs available for sharing at no cost or the cost of reproduction, or for a fixed sales price or rental fee. Space limitations prohibit printing more than the representative sources given below; however, these as well as some *50* other catalogs and lists are available at OCI, either for individual search by members of the computer community or for OCI staff use to respond to specific requests:

**Business Software Information Service,** Loose-leaf, 1970, Business Press International, Inc., Elmhurst, Ill.

**Computer Program Abstracts,** Quarterly, National Aeronautics and Space Administration, Office of Technology Utilization, Washington, D.C. (available on subscription basis from Superintendent of Documents, Washington, D.C.

**Computer Programs for Chemistry,** Delos F. Detar (Editor), W. A. Benjamin, Inc., New York, N.Y. Vol. I, 1968, 208p; Vol. II, 1969, 260p; Vol. III, 1969, 270p.

**Computer Programs for Oceanography,** Publication C–5 (1st rev.), 1967, 93p, National Oceanographic Data Center, Washington, D.C.

**Computer Software Catalog,** Microfiche, August 1970, National Cash Register Co., Dayton, Ohio.

**Datapro 70. The EDP Buyer's Bible,** Loose-leaf, 1970 (Section 70 E—Software), Datapro Research Corp., Philadelphia, Pa.

**European Software Catalogue,** Loose-leaf, 1970, International Software Services, CH 1605, Chexbres, Switzerland.

**ICP Quarterly,** International Computer Programs, Inc., Indianapolis, Ind.

**Software Age,** Monthly, Press Tech., Inc., Madison, Wis.

**Software Central,** Monthly Newsletter, Composition Information Services Inc., Los Angeles, Calif.

**Software Packages: An Encyclopedia Guide,** Loose-leaf, 1969, System Interaction Corp., New York, N.Y.

Inquiries concerning these Catalogs and lists may be addressed to the Office of Computer Information, Center for Computer Sciences and Technology, National Bureau of Standards, Washington, D.C. 20234, Phone (301) 921–3517.

## NUMERIC DATE-WRITING CODE ADOPTED

The world-wide membership of the International Organization for Standardization (ISO) has agreed to standardize the manner of writing numeric dates. How? By using the universally agreed system of descending order when writing numeric dates on any letter or document. This rule applies only when an all-numeric form is used, which might lead to confusion. To be precise, ISO recommends that if numbers only are used, the first day of April 1971 should be written 1971–04–01. For technical reasons, the hyphen is recommended as a separator rather than the point (.), the slant (/), or the space.

Provided that the month is clearly and editors of primary journals. Dr. spelled out (even in an abbreviated form) one can write the date however one wishes—1 April 1971, April 1 1971, or 1971 April 1. There is no ambiguity as long as a four character year is used, and no standard is required for writing dates in this form. However, when an average U.S. citizen writes the date 4–1–1971 to indicate April the first, a European or person in the military services, for example, would read the date as the fourth of January.

After studying all the implications of the question, an ISO committee of experts recommended the *descending* order and ISO Recommendation 2014 has now been approved by 25 countries.* Four countries only (Czechoslovakia, Ireland, Norway and Iraq) disapproved the proposal—they preferred the ascending order. Four more countries (Australia, Denmark, New Zealand, and Turkey) abstained.

The ISO committee concluded that the advantages of the *descending* order clearly outweighed any disadvantages. In particular, they cited:

—the ease with which the whole date may be treated as a single numeral for the purpose of filing and classification (e.g. for insurance or social security systems);

—arithmetical calculation, particularly in some computer applications;

—the possibility of continuing the order by adding digits for hour-minute-second.

Because a standard is of little use unless it is widely known and understood, ISO now seeks the cooperation of men and women all over the world.

## STANDARD FOR NUMBERING WEEKS

A second document, ISO Recommendation 2015, provides an agreed standard for the numbering of weeks. The calendar week is an important unit for planning and accounting purposes. Delivery dates in purchasing contracts and similar documents are frequently designated by referring to a certain week number. Since methods of numbering the weeks vary from country to country, a uniform system for the numbering of weeks has an increasing importance for international trade and industrial planning.

Briefly, ISO recommends that Monday (rather than Sunday) be regarded as the first day of the week for business and commercial purposes. ISO/R 2015 recommends, too, that the week should always be of seven days and that a weed divided by the turn of the year should be attached to the year containing the higher number of days of that week. Thus, for practical purposes, the first week of the year could begin, at one extreme, on December 29th and at the other extreme, on January 4th.

These ISO Recommendations were prepared by the DATCO (Date Code) Committee of ISO which met in Geneva in October 1969. Delegates attending this meeting were from France, Germany, Italy, Sweden, Switzerland, United States, and United Kingdom. George W. Frey of the Mellon National Bank of Pittsburgh was the U.S. delegate. Harry S. White, Jr. of the NBS Office of Information Processing Standards, Center for Computer Sciences and Technology represented ISO Technical Committee 97, Computers and Information Processing.

The American National Standards Institute (ANSI), the U.S. member body to ISO, cast the U.S. affirmative ballots on these recommendations. Copies of the ISO Recommendations can be obtained from ANSI.[1]

## COBOL RECEIVES ISO APPROVAL

The International Organization for Standardization Secretariat has reported that the draft recommendation on COBOL, developed by the X3 Computer and Information Processing Committee, has received approval from the members of ISO. The recommendation will be given the status of an ISO recommendation in the near future. The standard grew from the American National Standard COBOL (X3.23–1968) and is identical to it in technical content. Acceptance of COBOL internationally makes COBOL and its use available on a world-wide basis.

## REVISED FLOWCHART STANDARD AVAILABLE FROM ANSI

ANSI has announced publication of the revised American National Standard for FLOWCHART SYMBOLS AND THEIR USAGE IN INFORMATION INTERCHANGE, X3.5–1970 (Revision of X3.5–1968). This revision has been published to bring standardized flowchart language up-to-date. While it does not change the symbol shapes, it does modify several definitions and names so that they conform exactly to Flowchart Symbols for Information Processing, ISO Recommendation R 1028–1969. It also contains 13 additional symbols and their definitions. This standard is available from the American National Standards Institute,[1] $4.25 a copy.

## ANSI PUBLISHES REVISED BANK CHECK STANDARDS

Each year American bankers are faced with increasing problems as the volume of checks written grows by the hundreds of millions. Last year, according to the American Banker's Association, approximately 22 billion checks were written—or roughly eleven for every man, woman, and child in the world.

The American National Standards Institute has announced the revision of two of its standard which should facilitate swifter and more accurate automatic check-processing throughout the country. One of these helps to speed the processing of checks by standardizing their identifying magnetic characters while the other specifies the location of those characters on checks used in bank automation.

American National Standard X3.2–

*Austria, Belgium, Canada, Ceylon, France, Germany, Greece, Hungary, India, Italy, Japan, North Korea, South Korea, Netherlands, Poland, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, U.A.R., United Kingdom, U.S.A., Yugoslavia.

1970 (X3.2–1963 Revised), PRINT SPECIFICATIONS FOR MAGNETIC INK CHARACTER RECOGNITION, provides details of the font design, tolerances, and dimensions for the printed characters and symbols which appear on checks. The cost is $4 a copy.

American National Standard X3.3–1970 (X3.3–1963 Revised), BANK CHECK SPECIFICATIONS FOR MAGNETIC INK CHARACTER RECOGNITION, covers those design considerations that primarily govern the checks' identifying characters. The cost is $4.25 a copy.

These standards are available from the American National Standards Institute.[1]

## REVISION TO OCR (OPTICAL CHARACTER RECOGNITION) STANDARD

ANSI Sectional Committee X3 on Computers and Information Processing has accepted for publication and letter ballot a revision to the American National Standard on the Character Set for Optical Character Recognition (X3.17–1966). The revision, which was prepared by Subcommittee X3A1, contains four major additions and changes in the earlier version of the standard. These are: 1) the inclusion of a lower case alphabet; 2) replacement character shapes for the hyphen and apostrophe and alternate shapes for the period, comma, and question mark; 3) expansion of guidelines and specifications for spectral bands, paper and print characteristics; and 4) the addition of Character Erase and Groups Erase symbols (in the appendix).

Copies of the proposed revised standard are available for comment from the Business Equipment Standards Association, Standards Division, 1828 L Street, NW, Washington, D.C. 20036. Refere to document X3A1/70–31 (Revised September 25, 1970).

## MACHINE SENSIBLE DATA FILES AVAILABLE FROM NTIS

The National Technical Information Service (NTIS) of the Department of Commerce offers, as part of its continuing dissemination of information program, information in machine sensible form (magnetic tapes and punched cards) pertinent to various business, government, and scientific fields of interest. Information in this form is now available in the following fields of interest: Biological and medical sciences, chemicals, communications, data processing (including certain Federal Information Processing Standards), food and agriculture, information technology, transportation, management control-decision systems, earth sciences and mineral industries, and social sciences and education.

An announcement containing information on the files available and ordering information is available from NTIS, Customer Services Section, 5285 Port Royal Road, Springfield, Virginia 22151. Telephone (703) 321–8543. Refer to FAST announcement FA 71–47.

## NEW CONGRESSIONAL DISTRICT ATLAS ON DISTRICTS OF THE 92d CONGRESS

Users of FIPS PUB 9, Congressional Districts of the United States, (Representations and Codes) are alerted that the Bureau of the Census, U.S. Department of Commerce has published a new *Congressional District Atlas* (*Districts of the 92nd Congress*) which shows the boundaries of the 435 congressional districts of the 92d Congress. Page-size maps are provided to show congressional districts, for each State, for each county that is divided betweeen two or more congressional districts, and for each relatively small complexly divided area where Congressional district boundaries follow streets, corporate limits, streams, and other difficult-to-locate surface features.

In addition, the *Atlas* has two Congressional District Identification listings for each State. List A names counties and selected places alphabetically and identifies the congressional district in which each is located. List B names the counties alphabetically by congressional districts. Cross-referencing is thus readily possible between maps and lists.

The maps in this edition of the *Atlas* are arranged in alphabetical order by States and show redistricting actions to the end of November 1970. Since the 1968 edition (Districts for the 91st Congress) six States have been redistricted: Arizona, Hawaii, Louisiana, Missouri, New Hampshire, and New York.

Copies of the *Congressional District Atlas* (*Districts of the 92nd Congress*) may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at a cost of $1.75.

## NEW STANDARD METROPOLITAN STANDARD AREAS

Sixteen additional areas have been added to the 1967 list of Standard Metropolitan Statistical Areas.[2] Two of these additional sixteen were incorporated in FIPS PUB 8, Metropolitan Statistical Areas dated June 9, 1969; the remaining fourteen were announced by the Statistical Policy and Management Systems Division of the Office of Management and Budget on February 23, 1971.

FIPS PUB 8 is in the process of being revised to incorporate the new additions along with definitions of the areas and associated codes.

Those having a need to update their files prior to the publication of the revised FIPS PUB 8 may obtain a list of the additions from the Office of Management and Budget, Statistical Policy and Management Systems Division, New Executive Office Building, Washington, D.C. 20503. Refer to Second Amendment, Standard Metropolitan Statistical Areas, dated February 23, 1971.

[1] American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018.

[2] Executive Office of the President/Office of Management and Budget publication entitled "Standard Metropolitan Statistical Areas 1967." Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, 30 cents per copy, SD Catalog number PREX 2.2:M56/967.

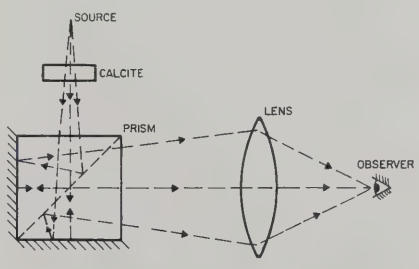
# NEAR-PERFECT INTERFEROGRAMS OF VARIABLE VISIBILITY

J. B. SAUNDERS OF THE NBS INSTITUTE FOR BASIC STANDARDS has developed a method [1] for producing cosine distribution interference fringes that are very straight, equally spaced, and whose frequency (width) as well as their visibility (contrast) can be varied. The technique should prove useful in the evaluation of lenses; for example, tests for resolving power are usually made by determining a system's ability to resolve points or lines with known spatial separation. The variability of visibility of lines (fringes) would add a new dimension in such tests.

In the NBS technique, a cube-type wavefront shearing interferometer [2] receives monochromatic light from a point or narrow slit source. Localized fringes may be observed visually from the focal point of a lens placed between the prism and the observer. The fringes can also be photographed at the lens focal point or by replacing the lens with a sheet of photographic emulsion.

Fringe contrast is varied by rotation of a calcite plate (cut parallel to any one of the cleavage planes), located between the source and prism. A property of calcite is its division of nonpolarized light into two polarized components, thus providing two mutually noncoherent sources, each of which, when acting alone, produces fringes of maximum visibility. A lateral separation of the two sources, produced by a rotation of the calcite plate, causes one set of fringes to become laterally displaced relative to the other. When this displacement equals one-half the fringe width, the contrast of the fringes is zero. When the displacement is zero the contrast is maximum. Thus any desired visibility may be obtained.

*Optics of the system for producing straight, equally spaced fringes with variable width and contrast.*



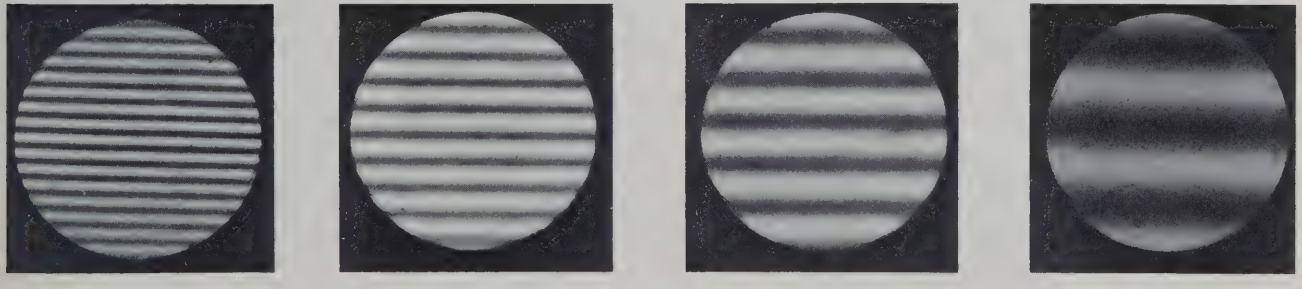

The thickness of the calcite plate determines the sensitivity of its rotation relative to changes in visibility. The thinner the plate, the less is the change in visibility for a given rotation. However, if the full range of visibility is required then the thickness must be sufficient to provide a change in separation of the two sets of fringes of one-half fringe width.

The width of the fringes may be adjusted by varying either the optical path or the angle of shear of the interferometer. The optical path is changed by varying the distance from the prism to either the source or lens. The angle of shear can be varied by rotating one component of the prism relative to the other about an axis normal to the beam-dividing plane. As the prism components are cemented, a more practical method of varying fringe width is to use several prisms of different shear values and to achieve intermediate variation in width by varing the optical path as mentioned above.

[1] Saunders, J. B., Production of near-perfect interferograms of variable visibility, J. Res. Nat. Bur. Stand. (U.S.), **74C** (1 and 2) 1 (Jan.–June 1970).

[2] Saunders, J. B., A simple, inexpensive wavefront shearing interferometer, Applied Optics, Vol. 6, No. 9, 1581 (Sept. 1967).

*Interferograms produced by new method are straight, equally spaced, and of variable contrast. Such interferograms should be very useful in the evaluation of lenses.*



# NBS Asked To Aid Mine Safety

The Bureau expects to make a direct contribution to the safety of coal miners in the United States. Since Congress passed the Coal-Mine Health and Safety Act of 1969, following the Farmington, West Virginia tragedy of the previous year, the U.S. Bureau of Mines' Systems Engineering Group (Department of Interior) in Denver, Colorado, has intensified its efforts toward improving the safety of coal miners. They have asked the NBS Electromagnetics Division in Boulder, Colorado, to serve as their consultant and technical advisor in matters relating to electronic devices and mine-communication equipment.

Through its history NBS has served as a central scientific and technological resource in meeting and in assisting other government agencies to meet national goals and needs. Under the present agreement, NBS will help the Bureau of Mines achieve better performance of their electronic, communications, and mine-systems engineering efforts, particularly those directed toward improving mine safety and health of coal miners.

Many mine systems, including mine communications and safety systems, both operating and emergency, require reliable and meaningful measurements and understanding of electromagnetic phenomena, and characterizations of electronic equipment and measurement techniques. These requirements can often be met simply, quickly, and inexpensively by early planning in the conceptual design phase of a system, but frequently are expensive if they are met on an ad hoc basis later in the design or operational stages. NBS will assist the Bureau of Mines in planning for these requirements by providing consultation and advisory services leading to more meaningful and accurate measurement techniques and to anticipating and thus avoiding potential systems problems.

## PASSIVE FILM *(Continued)*

### EXPERIMENTS

The objective of the NBS study was to determine the variables associated with the destruction of the passive films initially formed on the metal. For these experiments, a specimen was fabricated from high purity iron and exposed as the working electrode in an electrochemical cell to a buffered solution of sodium tetraborate/boric acid (pH 8.4). Using an auxiliary platinum electrode, current was passed to reduce any oxide film present on the iron, producing a bare metal surface. Then, using a potentiostat, the metal potential was quickly shifted to values where a passive film was produced, and the studies into the effect of chloride ions on both film growth and film breakdown were initiated. These growth and breakdown processes were observed using an ellipsometer, an instrument that measures changes in the state of elliptically polarized light at discrete wavelengths, upon reflection from a metal surface. Measurement of the relative phase retardation of the light allowed detection of changes in the thickness of the passive oxide film. Current density measurements were made in conjunction with the ellipsometric observations to characterize the growth and breakdown processes.

The effect of the chloride ion on the passivation process was studied by growing a film on a clean metal surface, as described, in a solution containing sodium chloride at a concentration of at least $3 \times 10^{-3}$ M. So long as the potential was mainained below about +0.24 volts (referenced to a normal hydrogen electrode), film growth was identical to that occurring in solutions containing no chloride ion—the films remained passive. At potentials much above this value, however, the film grew thicker and faster than in corresponding chloride-free solutions. This result, coupled with the much higher current densities in chloride solutions, indicates that passivation was not achieved, because severe corrosion would take place under such conditions.

This information was then used in the study of the breakdown of passivation on iron. Passive films were grown in the absence of chloride ion at potentials above that value previously found where passivation would not occur in solutions containing chloride ions. Measured amounts of sodium chloride solution were rapidly added to the passive iron system. After an elapsed time dependent on factors such as potential, time and temperature of film growth, and chloride concentration, breakdown was signalled by a sudden increase in anodic current density, followed by a rapid growth of a porous nonprotective oxide.

The following mechanism was proposed for explaining the passivity breakdown and onset of pitting for iron:

1. Adsorption of chloride ion at the oxide/solution interface, followed by its penetration to the metal surface.
2. Oxidation of $Fe^{2+}$ to $Fe(OH)_2^+$ which precipitates as a porous plug of $\gamma$-FeOOH.
3. Rapid dissolution of iron through the conductive paths thus generated, resulting in localized pitting.
4. Precipitation of $\gamma$-FeOOH at the oxide/solution interface.

[1] Ambrose, J. R., and Kruger, J., Breakdown of Passive Films on Iron by Chloride Ion, Proceedings of the Fourth International Congress of Metallic Corrosion, National Association of Corrosion Engineers, Houston, Texas (in press).

# NSRDS NEWS

*The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.*

## MAGNETIC TAPE FOR TEXT EDITING, FILE MANIPULATING AND AUTOMATIC TYPESETTING

The Office of Standard Reference Data has made available NBS Magnetic Tape 2, *Computer Programs for SETLST, KWIND, REFORM, AND EDPAC*, by C. G. Messina, R. McClenon, and J. Hilsenrath. This tape contains blocked card images, nine 80 character cards to a record, for a series of Fortran programs consonant with NBS Technical Notes 444, Reform, a general purpose program for manipulating formatted data files (40 cents, SD Catalog No. C13.46:444), 470, EDPAC: utility programs for computer assisted editing, copy production, and data retrieval (75 cents, SD Catalog No. C13.46:470), and 500, Edit insertion programs for automatic typesetting of computer printout (60 cents, SD Catalog No. C13.46:500) which are part of this package. These programs are used for data and file manipulation, for text editing and data retrieval, and for automatic typesetting of computer printout. The programs, developed by the staff of the Data Systems Design Group of the NBS Office of Standard Reference Data, are written in a proper subset of FORTRAN IV so that they can be run with little or no modification on any computer having a FORTRAN IV compiler.

The first file contains REFORM, a self-contained program with which it is possible to manipulate and edit files containing as many as nine different fixed-field card formats. It can select or abridge information from any of the cards and print that information, or reformat new cards in any desired order or arrangement. Provision is made for introducing as many as twenty-six arbitrary strings of characters, each of which may be up to seventy-nine characters in length, thereby permitting the insertion of labels, headings, or comments into the file.

The second file contains EDPAC, a package of five related utility computer programs: SCRAMBLE, SUBSTITUTE, SEARCH, BLOCKSEARCH, JUSTIFY, and their subroutines. These programs perform transformations on alphanumeric data. The programs have been written in FORTRAN, with care taken to make them as system and machine-independent as possible, permitting their use on many different computers.

SCRAMBLE scans an input file for specified characters, which it replaces by different characters. SUBSTITUTE similarly replaces strings of characters by other strings. SEARCH and BLOCKSEARCH scan for the occurrence of certain strings and list the lines or blocks, respectively, in which they occur. JUSTIFY produces text, for printing on a card-controlled typewriter or on an extended character printer, which has been left and right-justified between specified margins.

The third and fourth files contain the programs described in Technical Note 500. SETLST and KWIND are FORTRAN programs which accept a card deck or Fortran records on magnetic tape and insert the appropriate flags and shift symbols required by many of the "standard" typesetting programs associated with phototypesetting devices. The programs are specialized to the particular application, to the typesetting device and associated programs, and to the desired typeface, by means of control cards and substitution tables supplied at run time. The programs have application to program listings, KWIC indexes, and normal computer output. When the input is in tabular form the SETLST program permits more sophisticated operations including rearrangement, removal of trailing blanks, typeface changes between columns, etc. These programs can handle any records which can be read by a

FORTRAN READ statement under an A1 format.

The Magnetic Tape and the supporting documentation for NBS Magnetic Tape 2 can be purchased at $250 from the National Technical Information Service, U.S. Department of Commerce, 5285 Park Royal Road, Springfield, Virginia 22151. Parcel recipients are asked to return a registration card to the Data Systems Design Group, Office of Standard Reference Data, National Bureau of Standards, Washington, D.C. 20234, in order that the Data Systems Design Group may forward any supplementary material.

## BIMOLECULAR GAS REACTIONS

*Supplementary Tables of Bimolecular Gas Reactions* have been prepared by A. F. Trotman-Dickenson and E. Ratajczak under a grant from the Office for Scientific and Technical Information, London, as part of the British data program. The 100-page tables supplement *Tables of Bimolecular Gas Phase Reactions*[1] ($2, SD Catalog No. C13.48:9) by A. F. Trotman-Dickenson and G. S. Milne, 1967, which was issued as NSRDS–NBS 9. The new tables of reaction rate constants comprehensively cover the literature from 1 January 1966 to 31 December 1968. They can be obtained from the Publications Department, UWIST, Cardiff, CF1 3NU, Wales, United Kingdom, price $4, post free.

## BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES

The latest in a series of annotated bibliographies, *ORNL–AMPIC–13, Bibliography of Atomic and Molecular Processes for January–December 1969*, has been published by the Atomic and Molecular Processes Information Center, Oak Ridge National Laboratory. The work of the Center is under joint sponsorship of the U.S. Atomic Energy Commission and the NBS Office of Standard Reference Data. Literature related to atomic and molecular collision research is presented in this Annotated Bibliography. Bibliographical sources consisted of eighty-two scientific journals and three abstracting journals. References are catalogued under ten major categories with appropriate sub-categories. Each entry includes the following information: the reactants studied; the type of research (experimental or theoretical); the energy range; the author(s); and the journal or book reference.

## SYMPOSIUM ON PRINCIPLES AND PRACTICES OF DATA EVALUATION

The 1971 Annual Meeting of the international membership of CODATA, the Committee on Data for Science and Technology of ICSU, will be held in Washington, D.C., July 19–21. The National Academy of Sciences will host the meeting.

For this occasion, the Numerical Data Advisory Board will organize a one-day symposium and panel discussion on July 21, to which the members of CODATA will be invited. However, the meeting will be open, and it is anticipated that many U.S. scientists who are actively engaged in data evaluation will also attend. The symposium and panel discussion will be held at NBS, Gaithersburg, Maryland. The symposium will be held in the morning, the panel discussion will take place in the early afternoon, and following the panel discussion, the members of CODATA and guests will be given an opportunity to visit the NBS facilities.

The theme of the symposium is that the key element in high quality data evaluation is the use of proper techniques for handling both random and systematic errors. Speakers have been invited to deal with the following topics:

(1) application of statistical methods in error evaluation;

(2) evaluation of errors resulting from either using the wrong statistical tool, or from choosing the wrong physical model in the interpretation of the experimental data; and

(3) the evaluation of errors resulting from fallacies in experimentation.

The following speakers have accepted invitations: Dr. J. Ross Macdonald, Texas Instruments, Inc.; Dr. Gordon H. Dunn, Joint Institute for Laboratory Astrophysics; and Dr. D. N. Langenberg, University of Pennsylvania.

The panel discussion will deal with problems connected with the presentation of data in the primary literature, such as the economical aspects of presenting large amounts of data, and of presenting research results in sufficient experimental detail to allow a proper evaluation of the data. The panel will be composed of representatives from data evaluation centers and editors of primary journals. Dr. D. R. Lide, Jr., Chief, Office of Standard Reference Data, will act as moderator, and Dr. L. J. Kieffer, Director, JILA Information Center; Dr. Y. Touloukian, Director, Thermophysical Properties Research Center; Dr. D. Garvin, Director, Chemical Kinetics Information Center; and Dr. G. Janz, Director, Molten Salts Data Center, will represent data centers; and Dr. S. Pasternack, Editor, *Physical Review;* Dr. E. Westrum, Jr., Editor, *Journal of Chemical Thermodynamics;* and Dr. N. Hackerman, Editor, *Journal of the Electrochemical Society*, will represent primary journals.

There will be no registration fee, but a letter of intent to participate will be appreciated. This letter should be addressed to Dr. H. van Olphen, Numerical Data Advisory Board, NAS–NRC, 2101 Constitution Avenue, Washington, D.C. 20418.

## LIST OF NEUTRON CROSS SECTIONS COMPILATIONS

The European Nuclear Energy Agency (ENEA) Neutron Data Compilation Centre (CCDN) in its latest bulletin, *CCDN–NW/12 Newsletter Bulletin 12*, October 1970, revise a list of evaluations of neutron cross sections as of October 1970, previously compiled in CCDN Newsletter

No. 9, March 1969. The present newsletter also contains a listing of evaluated files held at the CCDN. The criteria for inclusion in the list have been that the material should be generally available, that it should give a complete set of data for input to neutronic calculations, and the full documentation should be provided in support of the evaluation. The large evaluated data sets are available on tape from the CCDN. Further information may be obtained by writing to CCDN, B.P.9, 91 Gif-sur-Yvette, France. The CCDN is part of the Organization of Economic Cooperation and Development and is financed by the following OECD member countries: Austria, Belgium, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

### PROTON INDUCED REACTIONS

A compilation of cross sections of reactions produced by protons on targets of protons, neutrons, deutrons, and helium is presented in CERN/HERA 70–2, *Compilation of Cross Sections I. Proton Induced Reactions*, by J. D. Hansen, D. R. O. Morrison, N. Tovey and E. Flamino. Included are graphs of the variation of cross section with incident momentum. Values for the rate of decrease of cross section with incident momentum are also given. This compilation is available in the western hemisphere and far east from the Lawrence Radiation Laboratory, Berkeley, California 94720. Users elsewhere should order the publication from CERN, Geneva.

[1] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

## DESIGN PACKAGE (*Continued*)

interested in producing the Type II system may request free information giving extensive details and specifications of the system. In addition, a package of printed-circuit-board negatives, panel artwork, sheetmetal drawings, and operating manual (schematics, maintenance and alinement procedures, parts lists and theory of operation)—all information needed to undertake production—is available for less than $150. Enterprises will be granted a royalty-free license to produce and sell the unit, on which patents are pending. If enough interest is shown, a seminar may be held in Boulder covering the theory and operation of the units, production hints, jigs, and test equipment. Consultation services will also be available to producers.

Contact the Electromagnetics Division, National Bureau of Standards, Boulder, Colorado 80302, telephone (303) 447–1000, ext. 3131, for the above materials and information.

[1] The NBS Type II Power Measurement System, by N. T. Larsen and F. R. Clague, Paper 712–70, presented at ISA–70 Meeting, Oct. 26–29, 1970, Philadelphia, Pa.

## BREAKTHROUGH (*Continued*)

To encourage production and operating arrangements with labor organizations and other labor forces for more effective use of our full labor force in overcoming the already existing and worsening shortage of skilled labor. To encourage developments and use of new techniques and materials. To encourage the development at the State Government level a concern with and a capability for the development of housing based on the improved approaches that are expected from this program. To seek innovative and expanding financing mechanisms, recognizing that basic reform in monetary institutions and regulatory laws may be needed.

In short, to provide a significant increase in industrialized housing in the United States with improved design, high quality, good living configuration, and more effectively controlled costs.

In the area of health and safety, the BREAKTHROUGH criteria were designed to produce levels of performance at least as good as those obtained under the present codes. In addition, "targets of opportunity" were incorporated; for example, the BREAKTHROUGH criteria call for more smoke detectors than do most building codes. Because they are aimed at housing that is not only safe but of improved quality, the BREAKTHROUGH criteria are quite broad, ranging into areas of liveability and durability. This need to go beyond the concerns of the codes stems from the nature of some of the housing systems; innovations that have not withstood the test of time or the natural selection processes of the marketplace necessitate criteria offering assurance of certain measures of liveability and durability.

The criteria for BREAKTHROUGH housing were designed and developed by a team of NBS building research experts. The team in only two months time produced the first of four volumes of guide criteria. The team also provided HUD with climatological and regulatory (codes, etc.) data pertaining to the sites for housing. In July, Secretaries George Romney and Maurice H. Stans signed a HUD/Department of Commerce interdepartmental agreement authorizing use of the technological resources of the Bureau in broad HUD programs dealing with housing.

Th 22 housing system producers for BREAKTHROUGH will construct prototype housing at nine sites—representative of every sector of the country. The nine sites are located in Indianapolis; Jersey City; Kalamazoo; Macon, Georgia; Memphis; Sacramento; St. Louis; Seattle; and King County, Washington.

# CONFERENCE & PUBLICATION *Briefs*

## SCHEDULED NBS-SPONSORED CONFERENCES

*Each year NBS sponsors a number of conferences covering a broad range of topics in science and technology. The conferences listed below are either sponsored or cosponsored by NBS and will be held at the Bureau's Gaithersburg, Md., facility unless otherwise indicated. These conferences are open to all interested persons unless specifically noted. If no other address is given, inquiries should be sent to the person indicated below in care of Special Activities Section, Room A600, Administration Building, National Bureau of Standards, Washington, D.C. 20234.*

**Fourth Joint Meeting of Operations Researchers.** May 24–26. Cosponsors: College on Logistics of the Institute for Management Sciences (TIMS); Mathematical Society of America; American Society for Cybernetics; American Society for Public Administration; Association for Computing Machinery; Operations Research Society of America. Contact: Lloyd Burden (NBS Technical Analysis Division).

**Summer Symposium in Analytical Chemistry.** June 16–18. Cosponsor: American Chemical Society (Division of Analytical Chemistry). Contact: R. A. Durst (NBS Analytical Chemistry Division).

**Fifth Symposium on Temperature Measurement and Control in Science and Industry.** June 21–24. Cosponsors: American Institute of Physics; Instrument Society of American. Contact: H. H. Plumb (NBS Heat Division).

**NBS Measurement Seminars, 1971 Series.** Two- to four-day courses on measurement and calibration problems. Attendance limited. See September 1970 *Technical News Bulletin* for detailed information.

## SPACE SIMULATION

A Conference on Space Simulation was held at NBS in September 1970. The Proceedings of the Conference are now available as NBS Spec. Pub. 336, J. C. Richmond, Editor, 984 pages, $5.25, SD Catalog No. C13.10:336. This volume contains 59 papers on such topics as contamination ablation, degredation of materials, predictive testing, radiometry, cryopumping, and operation of space simulation facilities. In addition a wide range of special studies are described, including: gravity simulation, with neutral buoyance for zero gravity and a man-rated centrifuge for high gravity; use of a drifting submarine to study the psychological aspects of long-duration missions in a space station; and simulation of (1) atmospheric balloon environments, (2) radiation from nuclear power sources, (3) solar wind, (4) micro-meteoroid bombardment, (5) soil friction on the moon, and (6) the Martian atmosphere.

## HEARING AIDS

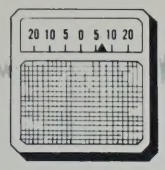
After taking the necessary first step of obtaining a professional medical diagnosis, a person needing a hearing aid is faced with a difficult decision: which instrument provides the greatest benefit? *Hearing Aids* (by E. Corliss, NBS Monograph 117, 35 cents, SD Catalog Number C13.44:117), contains information that should make this decision easier.

After an elementary account of some pertinent properties of sound and hearing, including the effects of resonance and "recruitment", it describes the general characteristics of hearing aids and offers advice on how to judge the performance of an instrument (some tests are included), how to select a hearing aid from among those commercially available, and how to care for it after it is obtained.

An appendix gives names and addresses, arranged according to State, of roughly 500 "hearing centers" in the United States, most of them nonprofit enterprises under the auspices of local universities or hospitals. Hearing tests, auditory and speech training, instruction in lip reading, advice on hearing aid selection, and even medical examination are often available from these centers, and for a very nominal fee.

## COMPREHENSIVE STRENGTH OF SLENDER CONCRETE MASONRY WALLS

*Compressive Strength of Slender Concrete Masonry Walls* by Felix Y. Yokel, Robert G. Mathey, and Robert D. Dikkers, NBS Building Science Series 33 (Dec. 1970, 32 pages, 40 cents, SD Catalog No. C13.29/2:33), describes an investigation to determine and analyze the effects of wall slenderness and load eccentricity on the strength of slender concrete masonry walls. Sixty reinforced and unreinforced walls of different slenderness ratios were tested to failure under vertical loads applied axially and at various eccentricities. Prism specimens, made of similar masonry units and mortars, were also tested under the same loading conditions. Analysis of the test results indicates that wall strength can be conservatively predicted by evaluating cross-sectional wall capacity on the basis of prism strength, and then reducing the capacity for slenderness effects by evaluating the added moments attributable to wall deflection.



# STANDARDS AND CALIBRATION

## STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Maui, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. The NBS time scale, UTC(NBS), and the U.S. Naval Observatory time scale, UTC(USNO), are jointly coordinated to within $\pm 5$ microseconds. The UTC pulses occur at intervals that are longer than one coordinate second by 300 parts in $10^{10}$ during 1971, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on June 1, 1971.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be no adjustment made on June 1, 1971.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

## NEW MICROPHONE CALIBRATION SERVICE

The Bureau has initiated a new microphone pressure calibration service covering the frequency range from 1 to 500 Hz. The new service is intended to fill the needs of persons engaged in geoacoustics work or in sonic boom measurements. This service, listed under item 213.011c of the test fee schedule,[1] can be performed on Western Electric Company type 640AA condenser microphones, or equivalent, for a fee of $330.

Pressure response levels of microphones submitted for test are measured by comparison with NBS reference standard microphones calibrated by the reciprocity technique. For a calibration, the test microphone and a reference standard are inserted into a small enclosure in which a uniform sound pressure is generated at discrete frequencies. The apparatus is arranged so that only the front of the microphone diaphragm is exposed to the sound pressure. Thus, the response levels reported apply for this condition only, since exposure to sound pressure of the back of a microphone diaphragm (through the pressure equalizing leak) in addition to the front may alter the response appreciably.

Inquiries should be directed to the Sound Section, Building 233, Room B106, National Bureau of Standards, Washington, D.C. 20234. Phone 301–921–3607.

[1] For a complete list of NBS calibration services, see Calibration and Test Services of the National Bureau of Standards, Nat. Bur. Stand. (U.S.), Spec. Publ. 250 (1970 ed., $2; SD Catalog No. C13.10:250).

# PUBLICATIONS of the National Bureau of Standards*

## PERIODICALS

*Technical News Bulletin*, Annual Subscription: Domestic, $3; foreign, $4. Single copy price 30 cents. Available on a 1–, 2–, or 3–year subscription basis. SD Catalog No. 13.13:54.

*Journal of Research of the National Bureau of Standards*

*Section A. Physics and Chemistry.* Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies. SD Catalog No. C13.22/sec.A:74.

*Section B. Mathematical Sciences.* Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.B:74.

*Section C. Engineering and Instrumentation.* Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.C:74.

## CURRENT ISSUES OF THE JOURNAL OF RESEARCH

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Simmons and Pedro B. Macedo.
Phase relations in the $SrO$-$IrO_2$-Ir system in air. C. L. McDaniel and S. J. Schneider.
The crystal structure of $BaCa(CO_3)_2$, (barytocalcite). B. Dickens and J. S. Bowen.
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*This column lists all publications by the NBS staff, as soon after issuance as possible. For completeness, earlier references not previously reported may be included from time to time.*

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**Publications with prices and SD Catalog numbers indicated may be purchased directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: one-fourth additional). NBS nonperiodical series are also available from the National Technical Information Service (NTIS) Springfield, Va. 22151 (formerly the Clearinghouse for Federal Scientific and Technical Information). Reprints from outside journals and the NBS Journal of Research may often be obtained directly from the authors.*



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